Office of Technical Assistance Research Proposal

ALTERNATIVES FOR LEAD BASED HEAT STABILIZERS IN CHLORINE CONTAINING POLYMERS

BACKGROUND

Litharge or lead monoxide is used in the insulation compound as acid receptor for hydrogen chloride (HCL) generated during extrusion and vulcanization processes to form a water insoluble chloride salt. It is an essential ingredient for chlorine containing polymers such as PVC , Neoprene and others, which are commonly used as wire and cable insulation compounds. Without an acid receptor, the HCl would be free to form soluble salts, which would encourage the absorption of water by the insulation. End users specify that the finished product meet certain water absorption criteria as determined by an ASTM test method and temperature. Other materials that have met with moderate success in acting as acid receptors include; organic lead bases; epoxy resins and epoxidized oils; magnesia; zinc salts. The literature contains references to other materials but insulation compounded with litharge still yields the best water absorption characteristics.

Litharge is incorporated in the compound formulation at a rate of 5 –25 parts/hundred (PHR). It is added as a litharge dispersion in ethylene/ propylene rubber. The ingredients are combined in a banbury; dumped onto a 2-roll mill; ribboned and then extruded. The extrusion is sent over to the next building where it is extruded again onto copper wire and vulcanized in one of three ways; 1) steam vulcanization; 2) hot salt vulcanization; 3) plastic wrapped and heated.

According to one cable manufacturer, the wire and cable industry is eager to replace or eliminate lead from wire insulation compounds for a variety of reasons. One reason is that all cable destined for underground applications must pass a TCLP test. Most cable with a lead containing insulation will leach lead at a concentration greater than 5 ppm. Therefore, any new system, material or process developed by State university researchers for this application would be seriously considered.

SCOPE of PROBLEM

Compounds of lead are used extensively as stabilizers for rubber and plastic materials. A review of current state databases has revealed the following information on lead usage by manufacturers in the Commonwealth according to Standard Industrial Classification numbers:

No. of Companies	SIC	Usage, lbs	Products Manufactured
1	3069	990,000	Fabricated Rubber Products nec
1	3081	155,375	Unsupported Plastic Film
6	3087	1,634,662	Custom Compound Purchased Resin
2	3089	1,970,523	Plastic Products nec
15	3357	4,160,154	Nonferrous Wire Drawing and Insulating
TOTALS			
25		8,910,714	

These data clearly show that the majority of the lead compounds are used by the wire and cable industry, which is also, represents the greatest number of companies. It is obvious that any breakthrough in finding an alternative for lead stabilizers would have wide spread application in the commonwealth not to mention the opportunity it would have on the national scene. Another way of considering this problem is to extrapolate the amount of lead containing waste generated from the amount of lead compounds reported used. Lead compounds are incorporated

in the polymer mixes at a rate of 5 – 25 parts per hundred resins. This calculates to the generation of 36 – 180 million lbs of lead contaminated waste which requires special disposal procedures.

OBJECTIVES

Identify the mechanism by which lead monoxide reacts with the chlorine split from chlorine containing polymers during routine rubber processing. The literature intimates that the lead forms an insoluble salt with hydrogen chloride, which will not absorb moisture. This concept of the mechanism should be verified.

Secondly, the investigators should identify the materials that have shown some degree of success as replacements for lead to date.

The overall objective is to find a material that, when added to rubber compounds will either complex hydrogen chloride in a form that is water insoluble or prevent water absorption by the cured rubber by some mechanism other than chlorine fixing. There are materials that naturally repel water such as silicones and silicone treated materials. What about ion exchange resins? Or leaving some amount of unsaturation in the polymer to scavenge chlorine? Chlorine is usually readily absorbed by activated carbon.

Is there some chemical that is a true heat stabilizer that would inhibit the decomposition of chlorine containing polymers?

SCOPE OF WORK

This project would require the formulation, compounding (mixing) and molding of many rubber formulations to include a number of polymers such as:

Polyvinyl chloride
Neoprene rubber
Hypolan Rubber

Further, once a candidate compound shows promise it must molded, extruded, processed into a current finished product form for evaluation.

One wire and cable manufacturer has offered its facilities to evaluate new candidates and participate in a R&D program at the university level. This company mentioned that this subject is also being studied by the ACS Rubber Group on a National and Regional level.